Journal of Cardiology (2009) **53**, 288—292

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CARDIOLOGY
Official Journal of the Japanese College of Cardiology

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CASE REPORT

Coronary arterial spasm during adenosine myocardial perfusion imaging

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Received 5 June 2008; received in revised form 5 July 2008; accepted 15 July 2008
Available online 16 September 2008

KEYWORDS
Adenosine;
Vasospasm;
ST elevation

Summary Adenosine is widely used as a pharmacologic agent for stress myocardial perfusion imaging. Vasospasm as a side effect of adenosine has been reported a few times in other countries, but it has not been reported in Japan. A 65-year-old woman was admitted to our hospital because of chest pain at rest and during exercise. She underwent myocardial scintigraphy, to rule out myocardial ischemia. After adenosine infusion, she felt chest pain and the electrocardiogram (ECG) showed ST elevation in inferior leads. Adenosine infusion was stopped immediately. Her chest pain resolved, and the ECG reverted to baseline. Perfusion image presented reverse redistribution in inferior segments, and coronary angiography revealed insignificant lesions. Transient ST elevation during adenosine infusion is thought to be due to coronary vasospasm, judging from scintigraphic and angiographic findings.

Introduction

Adenosine is widely used as a pharmacologic agent for stress myocardial perfusion imaging. Although minor adverse effects such as flushing and chest pain are common, vasospasm as a side effect has not been reported in Japan as far as we know. Herein, we report a case that showed typical signs and symptoms of vasospastic angina during adenosine myocardial perfusion imaging.

Case presentation

A 65-year-old woman was admitted to our hospital because of chest pain in the morning. A month earlier, she had first felt chest pain when walking in the afternoon. The pain decreased following rest of approximately 5 min. Afterward, the chest pain appeared after she got up in the morning while

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0914-5087/$ — see front matter
doi:10.1016/j.jjcc.2008.07.017

having done housework. It improved after approximately 2 min of rest, but she felt a similar pain the next morning when she was sitting. She visited our hospital and was admitted the next day.

On admission, heart rate was 64 beats/min and blood pressure was 140/72 mmHg. Physical findings were unremarkable. No coronary risk factor was noted expect for hypertension. The resting electrocardiogram (ECG) was normal. Echocardiography showed normal left ventricular wall motion and left ventricular ejection fraction of 65%.

Oral medications were as follows: 150 μg/day levothyroxine sodium; 2 mg/day tizanidine hydrochloride; 18 mg/day betahistine mesilate; 10 mg/day paroxetine hydrochloride. No Ca-blocker was administered. With these medications, thyroid-stimulating hormone was low (0.01 μU/ml), but thyroid hormone was controlled within a normal range with free T3 of 2.84 pg/ml and free T4 of 1.90 ng/dl.

She was scheduled for pharmacologic myocardial perfusion imaging with adenosine infusion at 120 μg/(kg min) for 6 min, to rule out myocardial ischemia. The resting ECG showed a sinus rhythm. Her resting heart rate was 66 beats/min, and blood pressure was 143/92 mmHg. Three minutes after the initiation of continuous adenosine infusion, thallium-201 of 111 MBq was injected. Five minutes after starting adenosine infusion, she felt chest pain and her blood pressure fell to 80/60 mmHg. The ECG at that time showed ST-segment elevations in II, III, and aVF with reciprocal ST-segment

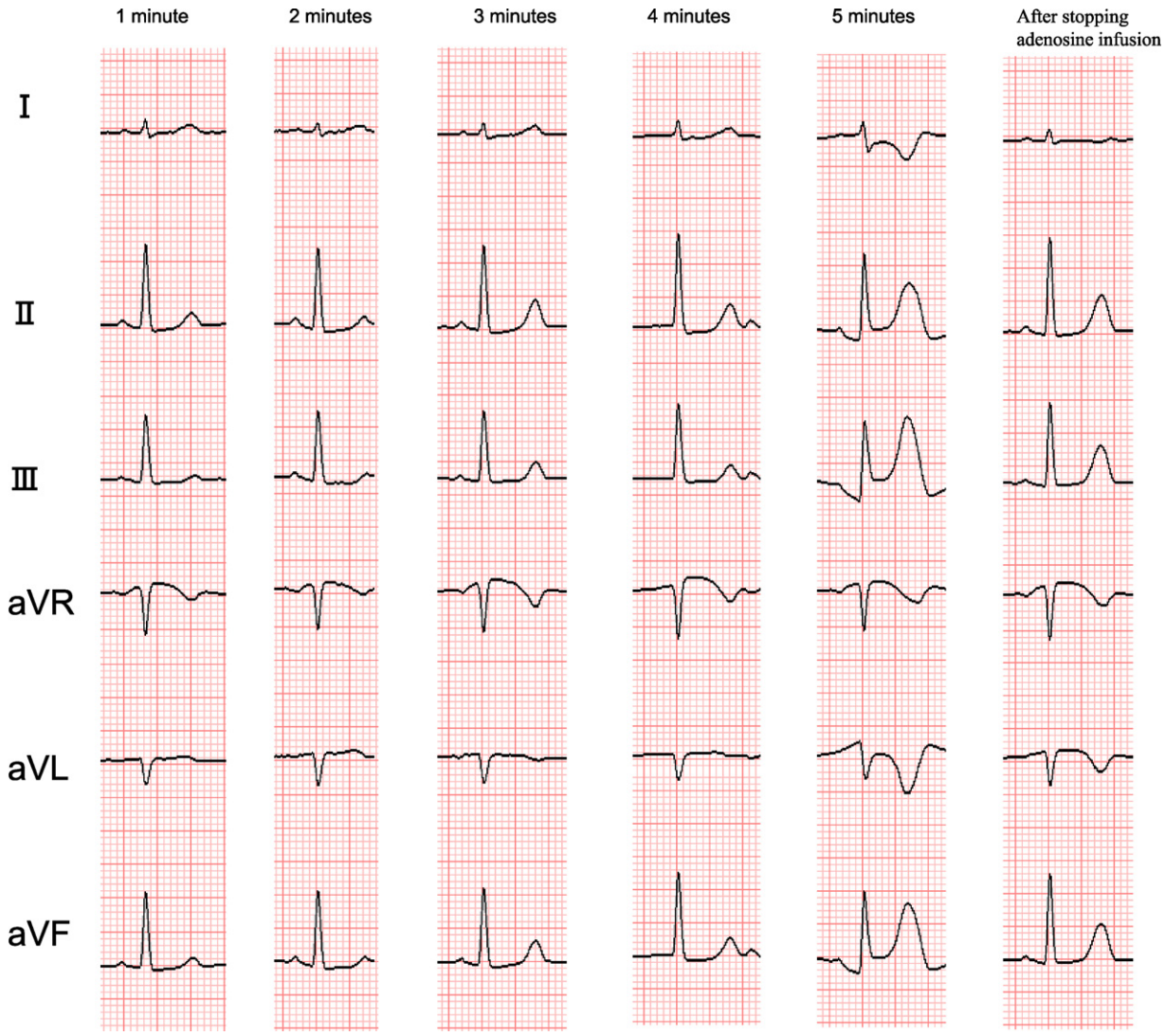

Figure 1 Electrocardiogram (ECG) during adenosine loading myocardial imaging. At baseline, no ST-segment abnormality was observed. Five minutes after adenosine infusion, ST-segment elevation was observed in leads II, III, and aVF, associated with ST-segment depression in leads I, aVL, V4, V5, and V6. These ECG changes resolved after stopping adenosine infusion.

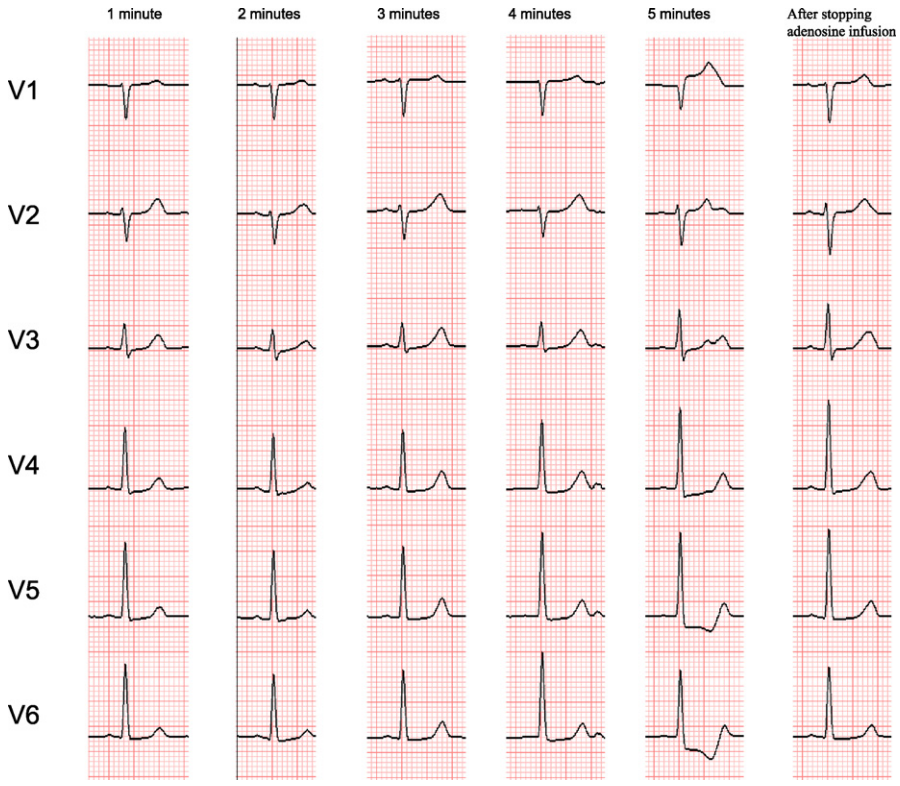

Figure 1 (*Continued*).

depressions in I, aVL, V4, V5, and V6 (Fig. 1). We stopped adenosine infusion and made her lie down. We did not give her sublingual nitroglycerin because of hypotension. Her chest pain resolved within approximately 4 min, blood pressure recovered to 110/78 mmHg, and her ECG reverted back to baseline. On tomographic image of thallium-201, reverse redistribution was observed in inferior segments (Fig. 2). Blood test did not demonstrate any elevation in cardiac biomarker after this event. No ECG abnormality was noted. Because the participation of vasospasm was considered, 100 mg/day diltiazem hydrochloride was started from the evening of myocardial perfusion imaging.

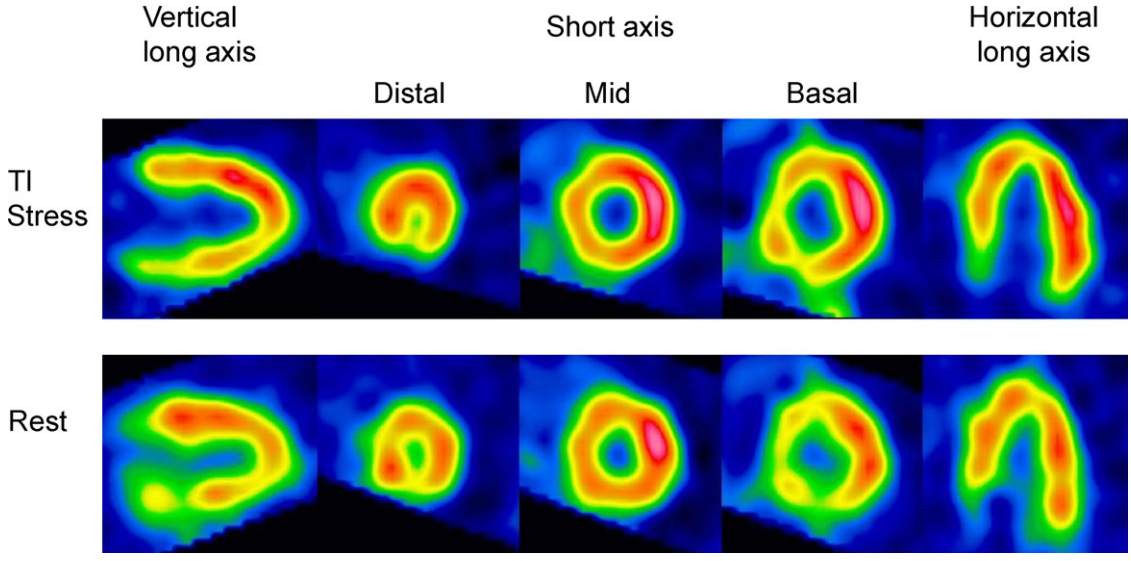

Figure 2 Thallium-201 myocardial imaging after adenosine infusion. Reverse redistribution was observed in the inferior segment.

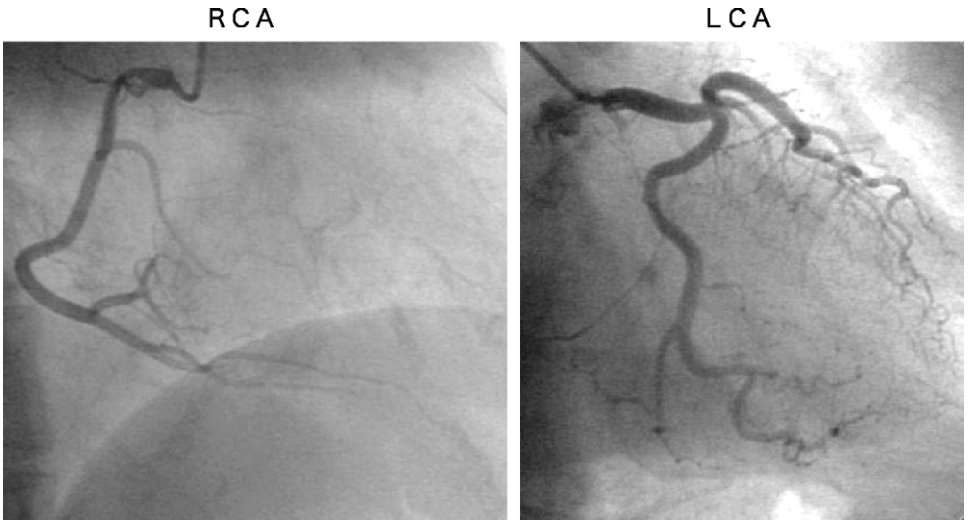

Figure 3 Coronary angiography revealed patent left coronary artery (LCA), and insignificant stenosis of 50% in the proximal right coronary artery (RCA).

On another day, coronary angiography revealed patent left coronary artery and an insignificant stenosis of 50% in the right proximal coronary artery; left ventriculography showed normal wall motion (Fig. 3). The acetylcholine stress was not done, because ST-segment elevation had been already documented during the adenosine stress myocardial perfusion imaging.

Discussion

In the present case, clinical features of adverse effects during adenosine infusion consisted of chest pain, hypotension, ST-segment elevation in leads II, II, and aVF, and reciprocal ST-segment depression (Fig. 1). Two major causes of chest pain associated with ST-segment elevation are acute myocardial infarction and vasospastic angina. In this case, the symptoms of the patient and subsequent ECG changes did not imply acute myocardial infarction. Moreover, blood test did not demonstrate any elevation in cardiac biomarkers after this event. Coronary angiogram also revealed no occluded lesion, but 50% stenosis at the proximal right coronay artery. Thus, we considered this transient episode during adenosine infusion might be caused by coronary spasm, although acetylcholine loading was not performed.

Thallium-201 myocardial perfusion imaging after this episode revealed reverse redistribution in the inferior segment (Fig. 2). This unique scintigraphic finding is usually observed in patients with cardiomyopathies or those who received successful coronary revascularization for acute coronary syndrome [1]. Although not common, reverse redistribution is also reported to occur in patients with vasospastic angina [2]. Therefore, the scintigraphic finding in this case was consistent with vasospastic angina. When ECG and angiographic findings were taken into consideration, the right coronary artery might be the culprit artery for vasospasm.

The first choice of stress method during myocardial perfusion imaging is exercise while the number of patients who cannot undergo the exercise stress, due to physical problems such as deconditioning, cerebrovascular diseases, vascular diseases, or left bundle branch block, is increasing. As an alternative stress method, vasodilator drugs are frequently applied. Among them, adenosine is widely used [3]. Although adenosine is contraindicated to patients with bronchial asthma, bradycardia or atrio-ventricular block, it rarely causes serious adverse reactions because of its short half-life (<10 s) [4]. Minor adverse effects such as flushing, dyspnea, chest pain, gastrointestinal discomfort, headache, neck discomfort, ST—T changes, and arrhythmias were often reported [5]. However, no Japanese case of vasospastic angina induced by adenosine has been reported as far as we know since the approval of this drug in Japan, although a few cases were reported in other countries [6—8]. It is not well understood how adenosine causes coronary spasm. Exogenous adenosine usually causes coronary vasodilation by stimulation of vascular K_{ATP} channels through adenosine-receptor activation. Although molecular structure and function of K_{ATP} channels are not yet fully elucidated, molecular abnormalities in K_{ATP} channels may, in

part, explain paradoxical coronary spasm induced by adenosine [9].

While adenosine myocardial perfusion scintigraphy remains a safe and effective test, the present case emphasizes that close ECG monitoring during the adenosine infusion as well as during the recovery period is important in differentiating nonspecific and benign symptoms often produced by adenosine from more serious reactions such as vasospastic angina.

Acknowledgments

The authors are grateful to Prof. J. Patrick Barron of the Tokyo Medical University International Medical Communications Center for his review of the English manuscript.

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